assistants, observed, at 9.45 p.m., an aurora appearing as a lustrous green light behind the nearest hills. The top of the mountain, "Sadlen," 1200 metres in height, was distinctly seen *above* the lustrous plane. The phenomenon rapidly disappeared. At 10.45 a light was seen in the south, which resembled that of dawn, and contracted into a faint shining cloud, oblong in shape, which oscillated slowly before the mountains "Hjortetakken" (1200 metres) and "Store Malene" (800 metres) at a distance of 8 to 12 kilometres from the station. The tops of the two mountains were distinctly seen *above* the luminous cloud, while at times small but intense spots of light developed themselves in it. When the cloud, at 11.45 p.m., had moved in front of the mountain "Lille Malene," the light became more intense, and had the appearance of a lustrous white cloud of smoke rolling up the hill to north-east. When the cloud travelled over the hill, the light became yellow, and was bordered by a coloured rim. At 11.10 it shot three faint red streamers up towards the zenith, and then the whole disappeared.

The following phenomenon was observed by the writer of these lines:—On November 14, 1882, at 6 a.m., I observed an auroral band without streamers through Vega, the Great Bear, and the Twins, while another stood parallel with this further west. From the "Store Malene" I now saw a peculiar shining white cloud descend into the fjord below. It descended in long, straight, shining bands. In a few minutes the mountain in question, as well as "Hjortetakken" were completely hidden in the cloud. A little further east the cloud possessed greater intensity, while on the plain at the foot of the hill on which the observatory stands, two luminous gatherings were seen, which seemed to rest on the snow, with a strongly phosphorescent light. These two gatherings, which were at first isolated, now came in contact with the above described cloud with long luminous bands radiating from the latter. By opening the slit of the spectroscope as much as possible and simultaneously keeping foreign light from the eye, I beheld the auroral line faintly but clearly defined. The cloud now began to disappear without oscillation, when suddenly a number of horizontal openings formed in it, through which the mountain stood forth. In the next second all had disappeared.

I admit that, as regards the last described phenomenon of the lustrous cloud, it might be explained as being caused by the reflex of the auroræ which were simultaneously visible; but such an explanation is not applicable to the one first described. It would be very interesting to learn if other observers have noticed this form of the aurora.

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THE EFFECTS OF THE WEATHER UPON DEATH RATE AND CRIME IN INDIA

SOME time ago a very interesting series of articles, by Mr. Buchan, upon the connection between certain meteorological conditions and the zymotic diseases, as illustrated by the mortuary returns of the London district, appeared in NATURE. Happening to have undertaken, at the request of the provincial superintendent of census operations, certain investigations concerning the life statistics of the population of the North-West Provinces and Oudh, just about the time when Mr. Buchan's articles appeared, it occurred to me that it would be worth while to see whether any similar concomitant variations of meteorological conditions and causes of death could be detected in India. The results arrived at are so curious, and at the same time so definite, that I think they may be of interest to readers of this journal.

At starting, however, it should be observed that, though the mortuary returns of the province with which I am connected are probably the best in India, they are still very far from complete. The agency employed for registration is that of the village *chaukidár* or watchman, who is supposed to take note of all births and deaths which occur in his village (aiding his memory, if necessary, by variously cut notches on a stick) and to report these weekly at the nearest police station. From such an agency nothing like an exact account of the causes of death can be expected; hence in the detailed tables given below I have confined my attention to the four most obvious causes—small-pox, cholera, suicide, and wounds. Even as regards the number of deaths registered a considerable defect may confidently be anticipated, owing to lapses of memory on the part of the *chaukidár*. This defect has been found by Dr. Plauck, the Sanitary Commissioner, to amount to about 20 per cent. of the whole on the average of a large number of cases personally examined by him in various parts of the province. The proportion thus obtained is confirmed by a comparison of the deaths actually registered with the death rate arrived at in the last census report. During the five years, 1878-82 (the only ones for which complete returns are obtainable), the deaths registered appear, from figures supplied by Dr. Plauck, to have numbered 7,311,013. The average population during the five years having been about 45,000,000, this gives an annual death rate of 32·5 per thousand. Now in Mr. White's report on the census of 1881 it is shown that the distribution of the population according to age, and the observed death rate among certain tribes and castes suspected of practising infanticide, and therefore placed under strict police surveillance, point to 40 per mille as the probable rate of mortality for the general population. The unrecorded deaths therefore amount on the average to 7 5 out of 40, or 19 per cent. of the total—almost exactly the same defect as Dr. Plauck arrived at by his personal investigation of special cases.

It follows that, though the returns collected by the rude illiterate agency employed are not strictly accurate, the totals arrived at probably on the whole bear a nearly constant proportion to the true number of deaths, the population dealt with being sufficiently numerous to eliminate any individual peculiarities of the agents.

The death rate varies enormously from year to year, as may be seen from the table of the total number of deaths recorded, here given in full:—

Number of Deaths from all Causes Registered in the North-West Provinces and Oudh during the Five Years 1878–82

Year	Jan.	Feb.	March	April	May	June	July
1878	137,161	140,173	143,760	157,326	136,867	120,767	91,677
1879	75,387	62,837	71,874	87,302	100,040	83,802	73,120
1880	116,366	72,030	69,250	72,534	76,622	78,200	56,502
1881	95,226	91,011	97,829	124,831	115,683	86,083	81,609
1882	114,220	92,472	96,596	107,628	119,714	114,382	122,110
Total	538,360	458,523	479,309	549,621	548,926	483,234	425,018

Year	Aug.	Sept.	Oct.	Nov.	Dec.	Annual total
1878	113,701	120,607	138,997	127,656	93,032	1,521,724
1879	131,702	196,135	429,115	369,390	233,795	1,914,499
1880	74,127	87,618	91,218	99,459	93,264	987,190
1881	86,316	109,837	181,519	180,683	151,846	1,402,473
1882	151,779	159,604	156,065	128,040	122,517	1,485,127
Total	557,625	673,801	996,914	905,228	694,454	7,311,013

The deaths recorded average a little under a million and a half per annum, but in 1880 they were less than a million, and in 1879 nearly two millions. In that disastrous year one district or county, that of Aligarh, lost nearly half a million of its population. The chief difference between 1879 and 1880, from the meteorological

point of view, was that in 1879 the monsoon rains were unusually heavy, while in 1880 they were so scanty that for a long time grave apprehensions were entertained of another famine, like that which followed the drought of 1877. The year 1877 (which does not appear in the table) was an extraordinarily healthy one, but the effect of the scarcity produced by the drought of that year is seen in the high mortality of the first six months of 1878.

The first rough generalisation suggested by the table is that dry years are healthy and wet ones unhealthy. That this is generally true is well known to residents in the country. Among the natives also I have heard it said that one must choose between health *plus* famine and abundance *plus* fever. It would nevertheless be false to infer that in India mortality is due to rain; for we have only to compare the figures for the several months to see that on the average, and in almost every single year, the month in which fewest deaths occur is July, which happens to be just the rainiest month of the twelve. Rain is no doubt one of the indirect causes of death; but it seems to produce unhealthy effects by increasing the humidity of the air and hastening the growth of rank vegetation, which, decaying at a time of the year when the air is almost perfectly still over the Indian plains, produces that noxious condition of the lower atmospheric strata known by the name *malaria*. Compared with the deaths from malarial fevers, those due to cholera, small-pox, and other epidemics count almost as nothing. Hence, though these epidemics have their particular seasons of maximum and minimum, their effect is completely hidden in the general mortality table under the great annual variation which culminates in October and November.

Besides rainfall, atmospheric humidity, and wind velocity, other meteorological causes which presumably have some effect upon health are the mean temperature and the daily range of temperature—the last, according to the prevalent opinion amongst Indian medical men, who are fond of attributing almost every ailment to nocturnal chills, being a most important cause. The next table gives approximate monthly mean values of all these meteorological elements for the North-West Provinces and Oudh, exclusive of the Himalayan districts, which are very sparsely populated.

Mean Values of Certain Climatological Factors in the North-West Provinces and Oudh

Month	Mean temp.	Daily range of temp.	Relative humidity	Rainfall	Wind velocity per diem
	°	°	%	inches	miles
January	59	28	62	0·8	54
February ...	64	28	57	0·5	71
March	75	29	46	0·3	83
April	85	32	37	0·2	90
May	90	28	43	0·7	93
June	91	20	52	3·8	108
July	85	14	75	11·4	95
August	84	14	77	9·5	80
September ...	83	16	74	6·6	70
October ...	77	27	62	1·3	47
November ...	67	32	55	0·1	35
December ...	60	30	61	0·2	40
Year... ...	77	25	58	35·4	72

Before proceeding to estimate the relative effects of these factors upon the death rate, it will be found convenient to convert the totals given in the first table into mean rates per annum. The mean number of deaths per annum for each million of population is 32,493, and this number is distributed over the months as follows, when the months are all reduced to the same length :—

Jan.	Feb.	March	April	May	June
2351	2201	2093	2480	2397	2181
July	Aug.	Sept.	Oct.	Nov.	Dec.
1855	2435	3040	4352	4083	3025

It has already been pointed out that the effect of the rainfall upon health is very indirect, and therefore need not be taken into account here. The relative effects of the other factors in the second table may be calculated approximately by the formula—

$$d = \alpha t + \beta r + \gamma h + \delta v.$$

Here d, t, r, h, and v respectively denote the variations of the death rate, the mean temperature, the range of temperature, the relative humidity, and the wind velocity each month from their mean annual values. From the twelve equations of this form, furnished by the monthly means, we get the following most probable values for the coefficients, viz. :—

$$\alpha = 79{\cdot}7 \qquad \beta = 113{\cdot}6$$
$$\gamma = 43{\cdot}4 \qquad \delta = -35{\cdot}6$$

If there be any approach to truth in the assumed proportionality between the variations of the death rate and of these climatological elements, it therefore appears that a mere rise of temperature within the limits observed produced comparatively little effect, one degree of increase in the mean temperature increasing the deaths about 80 per million per month, or rather less than one per thousand per annum. The variations of the diurnal range have a much greater effect, while the change of the death rate due to varying humidity is even less than that due to temperature changes.

The relation between the death rate and the movement of the wind is inverse, the proportionate increase of deaths being 35·6 per million per month for a decrease in the velocity of the wind amounting to only one mile in twenty-four hours. In the months of October and November, when so-called *malarial* diseases attain their maximum, the air is almost absolutely still; and there can be very little doubt that if a moderate breeze were occasionally to spring up at this time of the year, so as to dissipate the *malaria*, or at all events mix it with good air from other districts or from above, the effect would be an immediate decrease of the death rate.

As regards special causes of death, I have already stated that I have confined my attention to those cases in which the *chaukidár* may be trusted to make a correct diagnosis. Small-pox, a disease now happily almost banished from Europe, but still carrying off many thousands of victims annually in India, is one of these almost unmistakable causes. The average number of deaths from this disease during the five years was 59,240, distributed as follows :—

Jan.	Feb.	March	April	May	June
3195	3830	6611	12,561	13,790	9140
July	Aug.	Sept.	Oct.	Nov.	Dec.
4855	1924	742	366	536	1690

The deaths from this cause, numerous as they are, are fewest in the months when the general mortality attains its maximum. The meteorological causes which favour the spread of small-pox appear to be heat, drought, and possibly also an unusually high wind velocity, the solid particles which constitute the contagion being presumably blown about by the wind. The relative effects of these may be roughly computed from the totals for each quarter, using the formula—

$$n = N + \alpha t + \beta (100 - h) + \gamma v;$$

n being the recorded number of deaths in any month; N the number that would occur under the hypothetical conditions of a still, saturated atmosphere at 0° F.; and t, h, and v standing for the temperature, humidity, and wind velocity respectively. The coefficients thus found are $\alpha = 91$; $\beta = 237$; $\gamma = 97$; the condition most favourable to the propagation of small-pox appearing therefore

to be dryness. The number N, for the unattainable conditions assumed, comes out negative.

Another disease which the village watchman may be trusted to recognise in most instances is cholera. Cases of severe diarrhœa are doubtless frequently returned as cholera, but this does not sensibly impair the value of the registers, since the two diseases are usually prevalent about the same time. The mortality from cholera is subject to an annual variation quite as distinct as that of small-pox, but there are two maxima, in April and August, with a slight diminution between these months. The averages for the five years are :—

Jan.	Feb.	March	April	May	June
317	338	1304	9027	6541	6344
July	Aug.	Sept.	Oct.	Nov.	Dec.
5735	8129	4839	4665	1514	426

From the records of the army, police, and jail departments, extending over a longer series of years, it appears that the maximum mortality from cholera usually occurs in the rainy season. The secondary maximum in April becomes the principal one in this table on account of the excessive prevalence of cholera in April 1880. This epidemic was popularly attributed to the immense number of Hindu pilgrims assembled at the great religious fair of Hardwár, the disease having been caught from some infected persons in the crowd and spread abroad over the country as the pilgrims returned to their homes. The Sanitary Commissioner with the Government of India, however, does not accept this view, but seems to attribute the disease or its dissemination to some occult atmospheric influence. Whatever may ultimately prove to be the nature of the disease, there can be little doubt that in the North-West Provinces it is to a great extent dependent upon heat and moisture, being almost unknown in the cooler months of the dry season. To estimate the relative effects of these two atmospheric conditions, we may employ the formula—

$$n = N + \alpha t + \beta h;$$

the letters having similar significations to those mentioned with the previous formula. Combining the months in groups of four, commencing with December, we get three equations which give the following approximate results :— $\alpha = 281$; $\beta = 45$; $N = -20{,}076$. The principal effect is that due to high temperature ; while at the temperature assumed for N—zero F.—that number comes out negative. That is to say, in a perfectly dry atmosphere cholera would disappear at a temperature considerably above freezing, about 70° F., in fact, if we may judge from these tables. In the cold weather months, indeed, cholera never assumes epidemic proportions in the North-West Provinces ; but when the poison, whatever it may be, is widely disseminated, as in the beginning of 1882, after the great *mela* or religious fair at Allahabad, it remains nearly quiescent, manifesting itself only in a few sporadic cases until the commencement of the hot weather in April, when it breaks forth with alarming rapidity.

Deaths by violence are also, as a rule, unmistakable. In the Sanitary Commissioner's tables two causes of death are given which both come under this head—suicide and wounds—the latter presumably including only the results of murder and manslaughter, as there are separate headings for accidents and wild beasts. The average numbers of these deaths recorded each year are—

	Jan.	Feb.	March	April	May	June
Suicide ...	105	109	196	268	246	248
Wounds ...	105	94	105	119	125	128
Total ...	210	203	301	387	371	376
	July	Aug.	Sept.	Oct.	Nov.	Dec.
Suicides ...	246	242	269	250	151	100
Wounds ...	132	154	145	135	115	98
Total ...	378	396	414	385	266	198

Both series exhibit a distinct annual variation, notwithstanding some irregularities which would probably disappear if we had larger numbers to deal with, and in both the phases are similar, the minimum being reached in the middle of the cold weather, and the maximum in the hot season and rains. Both forms of death by violence are, in fact, manifestations of the same cause, irritability of temper ; for suicides in India are, as a rule, not the result of a fixed melancholia, three-fourths of the cases being those of young married women, who, finding life unbearable under the daily and hourly sting of the mother-in-law's tongue, end it at last by jumping down a well.

The monthly totals given in the last table may be approximately represented by the formula—

$$n = \alpha (t - x) + \beta h,$$

since they seem to depend both on temperature and humidity. In this formula x would be the temperature at which crimes of violence would disappear. Grouping the months in fours, commencing with November, we get three equations which give $\alpha = 7{\cdot}2$, $\beta = 2{\cdot}0$, and $x = 48{\cdot}4°$ F. Crimes of violence in India may therefore be said to be proportional in frequency to the tendency to *prickly heat*, that excruciating condition of the skin induced by a high temperature combined with moisture. Any one who has suffered from this ailment, and knows how it affected his temper, will readily understand how the conditions which produce it may sometimes lead to homicide and other crimes. And any one who has been in India in the cold weather and seen to what an abject condition the ordinary native is reduced by a temperature of 60° or so can believe that there is probably some truth in the arithmetical result above given, that about 48° crimes of violence would disappear, for at such a temperature nobody would possess a sufficient store of energy to enable him to commit crime of any graver description than petty larceny.

S. A. HILL

ALGÆ [1]

THE new work of Dr. Agardh, forms the third part of a series of monographs of algæ, two parts of which have already appeared. The first part contains the genera Caulerpa, Zomaria, and certain groups of Sargassum ; the second contains the Chondariaceæ and Dictyoteæ. The Ulvaceæ form the subject of the present monograph. This work should have special interest for algologists, from the circumstance that in it the author has expressed his views, and the reasons on which they are founded, concerning the much-debated question whether Bangia, Porphyra, Goniotrichum, and Erythrotrichia belong to the Florideæ or to the Ulvaceæ. The fact that Dr. Agardh still retains them among the Ulvaceæ is a sufficient proof that he is not convinced by the perusal of Dr. Berthold's work (noticed in NATURE, vol. xxvii. p. 385), and the statement of the latter that they belong to the Florideæ.

Dr. Agardh discusses the subject at some length, calmly and dispassionately ; and, considering his immense experience in the study of algæ, his opinion is deserving of much consideration. It may be as well to give the reader some idea of the arguments upon which the author has grounded his opinion. He relies principally, it will be seen, upon the assumed difference of the reproductive organs in the Ulvaceæ and in the Florideæ, namely, on the sporidia endowed with motion (zoospores) in the true Ulvaceæ ; and on the antheridia, cystocarps, and tetraspores of the Florideæ ; the antheridia and cystocarps being considered by Thuret and others as sexual, the tetraspores as asexual.

[1] "Til Algernes Systematik." Nya bidrag af J. G. Agardh (Tredje afdelningen). Lunds Arsskrift, tom. xix.

Dr. L. Rabenhorst's "Kryptogamen-Flora von Deutschland, Oesterreich, und der Schweiz." Zweiter Band : "Die Meeresalgen Deutschlands und Oesterreichs." Bearbeitet von F. Hauck. 4—6 Lieferung. (Leipzig : Eduard Kummer, 1883.)